New Jersey.—The mean temperature was 75.3°, or about 2.5° above normal; the highest was 107°, at Somerville on the 3d, and the lowest, 38°, at Charlotteburg on the 11th. The average precipitation was 4.96, or 0.68 above normal; the greatest monthly amount, 11.72, occurred at Asbury Park, and the least, 2.23, at Atlantic City.—*E. W. McGann.*

New Mexico.—The mean temperature was 72.5°, or 1.4° below normal; the highest was 105°, at Deming on the 30th, and the lowest, 37°, at Winsors on the 16th. The average precipitation was 3.86, or 1.18 above normal; the greatest monthly amount, 6.56, occurred at Fort Bayard, and the least, 0.90, at Bernalillo.—*R. M. Hardinge.*

New York.—The mean temperature was 72.5°, or 2.4° above normal; the highest was 103°, at Primrose and Westpoint on the 3d, and the lowest, 32°, at Franklinville, New Lisbon, and South Kortright on the 11th, and at Elizabethtown and Perry City on the 12th. The average precipitation was 2.80, or 1.03 below normal; the greatest monthly amount, 8.90, occurred at Liberty, and the least, 0.60, at Madison Barracks.—*R. G. Allen.*

North Carolina.—The mean temperature was 77.7°, or normal; the highest was 103°, at Goldsboro on the 2d, and the lowest, 49°, at Highlands on the 12th. The average precipitation was 6.98, or about 1.50 above normal; the greatest monthly amount, 15.97, occurred at Highlands, and the least, 1.97, at Goldsboro.—*C. F. von Herrmann.*

North Dakota.—The mean temperature was 67.5°, or 1.2° below normal; the highest was 106°, at Medora on the 5th, and the lowest, 28°, at Fort Yates on the 30th. The average precipitation was 2.74, or 0.37 above normal; the greatest monthly amount, 6.30, occurred at Wahpeton, and the least, 0.25, at Minot.—*B. H. Bronson.*

Ohio.—The mean temperature was 76.0°, or 2.8° above normal; the highest was 105°, at Warsaw on the 1st, and the lowest, 38°, at Greenhill and Milligan on the 11th. The average precipitation was 3.98, or 0.40 above normal; the greatest monthly amount, 10.65, occurred at Vanceburg, Adams County, and the least, 1.52, at Jacksonboro.—*H. W. Richardson.*

Oklahoma.—The mean temperature was 80.0°; the highest was 112°, at Purcell on the 8th, and the lowest, 51°, at Burnett on the 12th, and at Prudence and Sac and Fox Agency on the 13th. The average precipitation was 4.44; the greatest monthly amount, 9.82, occurred at Arapaho, and the least, 1.65, at Sac and Fox Agency.—*J. I. Widmeyer.*

Oregon.—The mean temperature was 66.0°, or 0.4° above normal; the highest was 119°, at Prineville on the 29th, the highest temperature ever recorded in Oregon; the lowest was 29°, at the same station on the 7th. The average precipitation was 0.46, or 0.02 below normal; the greatest monthly amount, 1.82, occurred at Government Camp, and the least, trace, at Ella and Umatilla.—*B. S. Pague.*

Pennsylvania.—The mean temperature was 74.8°, or 3.9° above normal; the highest was 107°, at Hamburg on the 3d, and the lowest, 33°, at Shinglehouse on the 11th. The average precipitation was 3.36, or 0.62 below normal; the greatest monthly amount, 6.29, occurred at Point Pleasant, and the least, 1.15, at Williamsport.—*T. F. Townsend.*

South Carolina.—The mean temperature was 80.0°, or 1.2° above normal; the highest was 102°, at Greenwood on the 4th, and the lowest, 54°, at Little Mountain on the 12th. The average precipitation was 7.81, or 1.68 above normal; the greatest monthly amount, 12.99, occurred at Charleston, and the least, 4.72, at Effingham.—*J. W. Bauer.*

South Dakota.—The mean temperature was 71.9°, or about normal; the highest was 112°, at Cherry Creek on the 5th, and the lowest, 32°, at Rochford on the 3d. The average precipitation was 3.06, or 0.15 above normal; the greatest monthly amount, 6.92, occurred at Wessington Springs, and the least, 0.19, at Nowlin.—*S. W. Glenn.*

Tennessee.—The mean temperature was 77.8°, or slightly above normal; the highest was 104°, at Elizabethton on the 2d, and the lowest, 51°, at Erasmus on the 11th, and at Springdale on the 12th. The average precipitation was 5.92, or about 1.25 above normal; the greatest monthly amount, 10.56, occurred at Sewanee, and the least, 2.09, at Covington.—*H. C. Bate.*

Texas.—The mean temperature for the State determined by comparison of 36 stations distributed throughout the State, was 1.2° below the normal. There was a general deficiency, but the deficit was slight in many localities. The highest was 110°, at Fort Ringgold and Fruitland on the 23d, and the lowest, 47°, at Valentine on the 2d. The average precipitation for the State, determined by comparison of 38 stations distributed throughout the State, was 0.08 below the normal. There was a slight excess over the panhandle, the east coast districts, and southwest Texas, while there was a general deficiency elsewhere, but not amounting to more than 1.00 except in a few localities over north Texas. The greatest monthly amount, 5.88, occurred at Breckenridge, while none fell at Rockport.—*I. M. Cline.*

Utah.—The mean temperature was 73.4°; the highest was 115°, at St. George on the 29th, and the lowest, 28°, at Soldier Summit on the 1st. The average precipitation was 0.35; the greatest monthly amount, 1.62, occurred at Levan, and the least, trace, at several stations.—*J. H. Smith.*

Virginia.—The mean temperature was 77.0°, or slightly above normal; the highest was 105°, at Bon Air on the 2d, and at Woodstock on the 3d, and the lowest, 44°, at Dale Enterprise and Hot Springs on the 11th. The average precipitation was 5.33, or 1.72 above normal; the greatest monthly amount, 13.74, occurred at Dwale, and the least, 2.27, at Stephens City.—*E. A. Evans.*

Washington.—The mean temperature was 64.9°, or about normal; the highest was 107°, at Centerville on the 31st, and the lowest, 33°, at Centerville on the 6th, and at Hunters on the 18th. The average precipitation was 0.54, or slightly below normal; the greatest monthly amount, 1.97, occurred at Clearwater, while none fell at several stations in the Yakima Valley.—*G. N. Salisbury.*

West Virginia.—The mean temperature was 75.0°; the highest was 103°, at Martinsburg and Wheeling on the 3d, and the lowest, 40°, at Beverly, Burlington, Dayton, and Uppertract on the 11th, and at New Martinsville on the 12th The average precipitation was 4.46; the greatest monthly amount, 8.33, occurred at Beverly, and the least, 1.53, at Rowlesburg.—*C. M. Strong.*

Wisconsin.—The mean temperature was 70.7°, or slightly above normal; the highest was 101°, at Medford on the 14th, and the lowest, 34°, at Neillsville on the 11th. The average precipitation was 2.87, or slightly above normal; the greatest monthly amount, 5.89, occurred at Westfield, and the least, 0.55, at Bayfield.—*W. M. Wilson.*

Wyoming.—The mean temperature was 67.4°; the highest was 105°, at Bittercreek on the 15th, and the lowest, 30°, at Four Bear on the 2d. The average precipitation was 0.86; the greatest monthly amount, 2.34, occurred at Wheatland, and the least, trace, at Wamsutter.—*W. S. Palmer.*

SPECIAL CONTRIBUTIONS.

CLIMATOLOGY VERSUS METEOROLOGY.

By Prof. MILTON WHITNEY, Chief of Division of Soils.

I have been much interested in reading the criticisms of the recent article of mine[1] contained in the April number of the MONTHLY WEATHER REVIEW, page 168, and that of Mr. R. DeC. Ward in the MONTHLY WEATHER REVIEW for May, page 214. These criticisms have brought out some very interesting additional facts. It is evident, however, that the main purpose of my paper was not clearly understood. The point I wished to make was the distinction between meteorology and climatology in order to emphasize the fact that we are not paying enough attention to the study of climatology. My definition of meteorology would be (*a*) the numerical data as expressed by our instruments of the various atmospheric phenomena at or near the surface of the earth; (*b*) the investigation of the laws of storm, of temperature, humidity, rainfall, light intensity, and other natural phenomena of the kind. Climatology, on the other hand, is the numerical relation of these phenomena as they concern the development of life and of industries as you properly suggested. The collection and tabulation of meteorological data does not meet this definition of climatology, and it is this that I particularly desired to emphasize. From the equation published in Science, it is evident that certain functions of temperature are numerically equal to certain other functions of humidity, wind velocity, and moisture as expressed in the development of plants; that is, in order to maintain a constant condition of plant growth, an increase of a few degrees of temperature must be followed by a fall in the velocity of the wind or by an increase in the humidity of the atmosphere, or by an increase in the moisture supply of the soil. All of these factors have more or less effect, according to the intensity of the heat and actinic effects of the solar radiations.

In calling attention to this it was desired to interest our meteorologists, if possible, in this study of the numerical relations of this phenomenon. We all know that if the

[1] Climatology as distinguished from meteorology. Science, January 25, 1898, VII, p. 113.

temperature increases within limits, the moisture content of the air should increase to maintain the condition of growth constant, and we know that a high temperature and a high wind velocity work together in taxing the powers of a plant. Now, for an increase of 10° in temperature, how much does the relative humidity need to be increased? Or what relation has the wind velocity per hour-mile to a degree in temperature in relation to the development of plants? If we have the same temperature and the same wind velocity over two successive periods, and the normal wind velocity over one, and twice the normal wind velocity over the other of the two periods, the effect upon a growing plant would unquestionably be great. With this increased movement, how much would the temperature need to be lowered in order that the conditions would be the same over each period and the wind not retard the development of the plant?

It seems as though numerical relations of this kind can be established between the principal meteorological elements. These numerical relations of the meteorological elements will unquestionably differ, as stated in my paper, not only for different plants, but for the same plant in different periods of its growth. The equation was intended really to show the variation in the climatic conditions from the normal. In order to use this intelligently of course the normal conditions must be worked out so that departures from the normal can be appreciated. As you say, the nature of the soil and the character of the plant has much to do with the development of the plant. That was taken for granted in giving to soil moisture a place in the equation, and in taking it for granted that the previous breeding of the plant used for establishing the relations in the equation had been known.

This equation is simply constructed to show the relation of meteorological data, and can be used, of course, with all life. I had originally intended to use the word "life" instead of the mere specific term "plant," but I decided upon the use of a plant as giving a more concrete form to the expression.

I hope you will see from this that these ideas of climatology are broad enough to include all life and human industries. The one formula, of course, will not stand, but the principal of equating the meteorological data should be applicable to the widest possible sphere. It is alike applicable to animal life and human industries as it is to plant life.

It seems to me that as yet we have very little "general climatology," and until the principles of this are well established and we know something of the relations of meteorological phenomena to life and industries, that it is hardly time to specialize, as Mr. Ward suggests, and have "agricultural climatology" and "anthropo-climatology," and what may come to be known as "industrial climatology." I think when Mr. Ward works out any units or relations between meteorological phenomena and man, that it can be connected with but little trouble with other forms of life and with human industries from what we already know of the relations between plant and animal life and human industries.

ERRONEOUS CONVERSION OF METRIC AND ENGLISH BAROMETER READINGS.

By Prof. C. F. MARVIN, Chief of Instrument Division.

The growing interchange of meteorological observations between the Weather Bureau and observers throughout the West Indies, Mexico, Central America, and elsewhere gives rise to many occasions in which readings of atmospheric pressure must be converted from French to English measures, or vice versa. We desire to caution observers and others against an errer which is liable to be committed in this connection when dealing with uncorrected readings of mercurial barometers with brass or similar scales affected by temperature. For example, suppose the readings of the attached thermometer and scale of a mercurial barometer graduated in metric units are:

Attached thermometer....	25.4° C.
Barometer reading......................	762.15 mm.

As it is desired to ascertain the corresponding air pressure in English units when the observer does not happen to have at hand a table giving corrections for temperature in metric units, he may now endeavor to use his table of corrections in English units instead, and will sometimes be inadvertently led into an error in making the conversion. That is to say, he will convert the temperature from Centigrade to Fahrenheit and the scale reading from millimeters to inches. In the present case this gives attached thermometer 77.7° and barometer reading 30.006. The temperature correction corresponding to 77.7° and 30 inches, as given by his table for English barometers, is —0.133, and he therefore concludes that the observed barometer reading in English units and corrected for temperature is 29.873. This process, however, leads to an erroneous result.

The correct conversion is found by taking the correction for temperature corresponding to 25.4° C. and 762 mm. from a table of corrections for temperature *in metric units*. In the present case the correction is —3.15 mm.; therefore, the corrected barometric reading is 759 mm., which converted into inches gives the true result, namely, 29.882 inches. The error thus pointed out results from two circumstances: First, that the metric and English scales of length are not standard at the same temperature; second, that all ordinary tables of barometric corrections for temperature include the effects of temperature on both the mercurial column and the brass scale. Scale readings of metric measures of length are standard at 0° C., that is, the freezing point, or 32° F.; whereas an English scale of inches is regarded as standard at 62° F. In both cases the height of the mercurial column is standard when the temperature is at the freezing point.

When, therefore, comparisons are being made between French and English barometers and all the readings are to be reduced to the same system of units, the observed readings must be separately corrected for temperature. This will require a table of corrections in metric measures for the French barometer and a separate table of corrections in English measures for the English barometer. The readings, after being thus corrected for temperature, are expressed in standard inches and millimeters, respectively, and may then be converted directly from one system to the other with correct results.

Generally the corrections for instrumental error and capillarity are so small that these may be applied either before or after correcting for temperature and the conversion of scale without appreciable affect on the result. If the corrections for instrumental error and capillarity are large, however, they should, to be strictly correct, be applied, after correcting for temperature, but before conversion to another system of units. Notwithstanding this rule, the graduated scale of barometers with relatively small tubes is often "set down," in order to compensate for the capillary depression of the mercurial column and to eliminate other instrumental imperfections which reduce the height of the column, such as an imperfect vacuum, for example. This setting of the graduated scale is an instrumental method of applying the correction for capillarity, etc.; but by applying it before and not after the correction for temperature it complicates the problem of attaining accuracy. However, any error thus introduced will ordinarily not exceed 0.001 of an inch, unless the depression of the scale is greater than about 0.2 of an inch.

We may remark, in this connection, that circumstances sometimes arise in which a Centigrade thermometer may be used to determine the temperature of an English barometer,